ECONOMIC RESEARCH

# Working Paper

September 2016

} MACROECONMICS } FINANCIAL MARKETS } ECONOMIC POLICY } SECTORS

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## Climate Risk Insurance: New Approaches and Schemes

Allianz

# Working Paper

## Climate Risk Insurance: New Approaches and Schemes

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## EXECUTIVE SUMMARY

Finding solutions for how to deal with the impacts of climate change is one of the most pressing issues of our time. It is the least and less developed countries which are the most affected by increasing frequency and severity of extreme weather events such as droughts or floods, while being the least capable of coping with them. Relying on ad hoc donor support creates uncertainties concerning the timing, size, and frequency of the payout which is desperately needed for mitigating the negative repercussions of weather extremes. Consequently, new viable and sustainable pre-disaster arrangements for transferring financial risks need to be found and implemented. Various general problems arise when setting up formal disaster risk transfer schemes in developing countries, which are mainly related to the concentration of risk, lack of data, low resilience of infrastructure, and potential for moral hazard.

On the one hand, classic insurance schemes on the micro, meso, and macro level, covering individuals, intermediaries, and countries, respectively, serve as a way to sharing weather-related risks and losses. Microinsurance is designed to directly meet policyholders' specific needs. Microinsurance schemes hedging against losses caused by extreme weather events have already been implemented in numerous African, Asian, and Middle-American countries. Meso-level insurance enhances investment potential by reducing losses caused by credit default and currently exists in regions in Central- and South America as well as South East Asian island states. Insurance on the macro-level allows both insured and uninsured individuals to be compensated for damage caused by extreme weather events. Two macro-level pooling facilities cover Caribbean island states and Sub-Saharan African countries.

On the other hand, alternative formal approaches to transferring weather-related risks may be pursued. Catastrophe bonds transfer risks to the capital market, thereby spreading them widely. They have mainly been issued by macro-level risk pooling facilities for reinsurance, but are increasingly being taken into consideration by public entities as a risk-sharing mechanism. Weather derivatives are another way of transferring risks to the capital market. A limited amount of projects have been piloting them in developing countries, mainly in Africa. Sovereign insurance enables highly exposed governments with a low tax base and a vulnerable infrastructure to hedge their liabilities against weather-related risks. Macro-level risk pooling facilities may be regarded as providers of sovereign insurance.

The mentioned mechanisms are vastly index-based, such that payments are disbursed if an index crosses a predetermined strike value, contrary to traditional schemes, where payouts are determined by actual losses. The index-based approach reduces administration costs and moral hazard, but creates substantial basis risk.

Climate risk insurance fosters sustainable economic growth and development of poor countries by compensating for instantaneous losses following an extreme weather event, providing resources for reconstruction and hence future production, reducing income inequality, motivating people to rebuild, and enhancing investment potential.

## 1. INTRODUCTION

The United Nations Framework Convention on Climate Change's (UNFCCC) key objective is to stabilize "greenhouse gas concentrations in the atmosphere in order to prevent dangerous anthropogenic interference with the climate system" (Article 2, UNFCCC 1992). In addition to such mitigation concerns, many developing countries have called for international assistance in adapting to the consequences of climate change (Dröge 2016). Market insurance and other financial risk-transfer mechanisms can be part of an adaption plan to reduce vulnerability to the direct impacts of climate change, namely more frequent and more severe extreme weather events with longer-lasting repercussions. However, many developing countries have underdeveloped weather-related insurance markets, which threatens development and poverty reduction (UNFCCC 2008). Hence, new viable and sustainable risk-transfer solutions need to be found and implemented. The Intergovernmental Panel on Climate Change's (IPCC) latest special report published in 2012 emphasizes the urgency of doing so. In preparation of the Conference of Parties (COP) in December 2015 in Paris, where both mitigation and adaption challenges were included in the final agreement's three main purposes (Dröge 2016, p. 30), the G7 launched an initiative on climate risk insurance. It aims to provide up to 400 million poor people with climate risk insurance by 2020 in addition to the 100 million people already covered (German Federal Ministry for Economic Cooperation and Development (BMZ) 2015).

In this paper, we use the terms climate and weather interchangeably , despite the fact that climate is usually referred to as "the average weather over time and space" (NASA 2005). We assume climate change to mainly manifest itself in a change in the frequency, severity, and long-term nature of extreme weather events such as floods, droughts, or storms, and we disregard other impacts such as rising sea levels.

This paper firstly presents different risk transfer mechanisms, followed by an overview of if, where, and how such schemes have already been established. The paper elaborates on the economic virtue of providing insurance for protecting against the adverse effects of extreme weather events. Finally, the paper will present a short conclusion with regards to the future outlook.

## 2. RISK TRANSFER MECHANISMS: DEFINITIONS, BENEFITS AND LIMITATIONS

There are numerous risk sharing and risk transfer strategies, which provide "pre-disaster financing arrangements that shift economic risk from one party to another" (IPCC 2012, p. 321). Aside from more informal coping strategies such as relying on international financial aid or kinship ties, individuals, communities, and countries can rely on insurance as a formal risk transfer mechanism (IPCC 2012, p. 322). Additionally, other formal approaches to transferring risks may be pursued. Many classic insurance products are difficult to implement or not viable at all in developing countries, mainly due to "the nature of disaster risks, lack of data, restrictive regulations, small scale of operations, and potential for moral hazard" (UNFCCC 2008, p. 6). This section firstly explains the underlying potential determinants of payouts, followed by a presentation of classic insurance schemes and other risk transfer approaches including their benefits and limitations.

### DETERMINANTS OF PAYOUTS: ACTUAL LOSS VS. INDEX

Traditionally, financial compensation of a disaster is directly related to actual losses. A comparatively new type of insurance – index insurance – "is linked to an index, such as rainfall, temperature, humidity or crop yields, rather than actual loss" (Hellmuth et al. 2009, p. 3). For example, policy holders are automatically compensated for a potential loss of crops in case a rainfall index falls below a certain level.

Due to the fact that no resources are required to be spent on thoroughly assessing and quantifying losses, contrary to the traditional mechanism, transaction costs are lower, implying potential for lower risk premiums. Moreover, payouts can be made more quickly, which does not only avoid distress sale of assets, but also contributes to averting severe poverty following a disaster, thereby alleviating migration and conflict. Index insurance is also subject to less adverse selection and moral hazard, since it does not matter whether one policyholder is more prone to risk than another and the payout is not linked to the crop's survival or failure, such that it cannot be influenced by the policyholder and preserves the incentive to make the best decisions. Moreover, index insurance requires less complex contracts. A substantial disadvantage of index-based payouts is basis risk, which occurs when actual losses do not equal financial compensation, making the insurance non-viable, or damaging livelihoods in the long run (UNFCCC 2008, p. 7; Hellmuth et al. 2009). Similar to traditional insurance, index insurance can be applied at the micro, meso, and macro level. Alternative risk transfer approaches are also frequently based on a weather index.

## 2.1 Classic insurance schemes

### MICRO-LEVEL INSURANCE

Microinsurance is specifically designed to protect low-income individuals and households directly against diverse risks in exchange for a regular small premium payment, where the sums insured are relatively small (IPCC 2012, p. 322; UNFCCC 2008, p. 52). During the early stages of implementation, schemes are often supported with technical and financial assistance in the form of lower risk premiums, for instance, in order to reduce market barriers (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) 2015).

Mechler et al. (2006) provide further insights on the characteristics, advantages, and limitations of microinsurance. Not only is it possible to protect against death or health problems, but also against loss of small-scale assets, livestock, and crops in case of a weather-related disaster. Group contracts are reported to be very common as they reduce the costs of issuing contracts and of processing premiums and claims. Microinsurance may be offered as a 'stand-alone' product, or it may be linked to a microloan, for instance, protecting the microfinance institution against loan default. Such a bundled scheme may additionally provide an incentive for strengthening resilience if the loan is used for financing resilience-enhancing measures (UNFCCC 2008, p. 53 f.), which may also be achieved by offering reduced premiums.

One major advantage is that microinsurance addresses individual policyholders directly, and ideally meets their specific needs, as opposed to indirect insurance schemes on the macro level, where losses are not assessed and quantified individually. It is reasonable to assume that policy holders, especially in case of an index-based scheme, can be compensated more quickly than through indirect insurance solutions on the macro level, where bureaucratic obstacles might delay payouts. Mechler et al. (2006) furthermore point out that an insurance contract is regarded as a "more dignified means of coping with disaster than relying on the ad hoc generosity of donors" (p. 6).

A considerable problem when offering microinsurance against weather-related disasters is that such disasters usually affect whole communities or regions at a time, causing a large number of claims at the same time (IPCC 2012, p. 323). As a consequence, schemes must be sold on a very large and diversified scale, which has been rarely achieved so far (International Labor Organization (ILO) 2012). In such cases insurers face insolvency risks or must rely on donor support (Mechler et al. 2006). Furthermore, since large parts of the population in developing countries are unfamiliar with the institution of insurance , investments in consumer education are needed (UNFCCC 2008, p. 53).

### MESO-LEVEL INSURANCE

At the meso level, insurance is sold to intermediaries providing goods and services to rural markets (UNFCCC 2008, p. 59). This insurance protects intermediaries, such as credit unions or microfinance institutions (GIZ 2015), or non-governmental organizations (NGOs), from losses which may occur if their clients or members experience losses from extreme weather events (Skees et al. 2007a, p. 9), for example loan defaults by farmers as a consequence of a severe drought (GIZ 2015). Insurance on the meso level may therefore be regarded as a direct insurance to intermediaries, or as an indirect insurance to the members or clients of the respective entity, who for example benefit through potential loan programs.

Providing insurance to meso-level intermediaries results in lower administration costs and achieves greater reach (Hazell and Rahman 2014, p. 234) “since they are generally smaller in size and larger individually in terms of assets” (UNFCCC 2008, p. 59). Moreover, intermediaries are more familiar with financial products (UNFCCC 2008), which reduces the need for resources to be spent on consumer education. Additionally, using an intermediary provides the possibility of bundling insurance with credit (as in the example above), and hence incentivizes smallholders sceptical or reluctant to take up microinsurance (Hazell and Rahman 2014, p. 234).

On the contrary, offering insurance on the meso level poses the problem that portions of the payout to the intermediary may be captured before being distributed to clients or members (Hazell and Rahman 2014). Furthermore, it is reasonable to believe that claims of members and clients are difficult to be met in a timely manner, as the payout to the aggregator needs to be determined and then processed first. Cascading payments further to individual clients increases the overall delay.

### MACRO-LEVEL / SOVEREIGN INSURANCE

At the macro level, entire regions or countries, or international charity organizations buy insurance in order to be able to fund recovery measures in case of an extreme weather event. As losses are most likely to be substantial at the aggregate level, the coverage is often provided directly by a reinsurer (Skees et al. 2007a). Regions, countries, or organizations may be insured individually, or they may be part of a risk-pooling facility.

By pooling risks at a supranational level, coverage may be provided “at a significantly lower cost than what governments [...] could obtain individually from the insurance market” (ILO 2012) as it allows broader risk diversification. This makes obtaining insurance coverage possible for countries, which would have otherwise not been able to afford it (GIZ 2015, p. 10).

Insurance on the macro level offers further advantages, especially if compared to meso-level and micro-level insurance. Firstly, in case of an extreme weather event, both insured and uninsured individuals benefit from direct payments or the provision of public goods (repaired roads and other infrastructure assets, for instance) by an insured government. Secondly, as indicated above, a natural disaster can wipe out entire portfolios of microinsurance risks since large claims have to be met all at once. Higher level schemes can fill this potential gap (ILO 2012). The GIZ (2015) claims that such an indirect insurance solution makes it possible to reach a large number of the poor and vulnerable within a short time, which limits the negative repercussions of extreme weather events that would otherwise be "heightened if provision of disaster relief is delayed" (p. 9). Following argument mentioned above, this claim may be doubted. One drawback of macro-level insurance is that it is impossible to target the specific needs of individuals. Especially if a large part of the population has to be compensated within only a short time frame after the disaster, individuals and households are likely to receive a lump-sum, which implies significant basis risk.

### Sovereign insurance: Definition and product overview

Sovereign insurance constitutes "all efforts taken by country governments or a private insurer to pool risks on a sovereign level" (UNFCCC [no date]). Sovereign insurance comprises both the coverage of micro entities on a sovereign level as a way to indirectly reduce the government's fiscal exposure to natural disasters, and direct coverage of the public entity itself.

National governments hold a large portfolio of public infrastructure and other assets which are exposed to climate risks. Governments also provide post-disaster financial relief and assistance to individuals, households and businesses, and they "may insure these liabilities through sovereign insurance" (IPCC 2012, p. 372). Sovereign insurance is defined as a risk financing strategy for governments and may include reserve funds, insurance, or contingent debt (Ghesquiere 2007, p. 4). It is hardly found in developed countries, where governments are capable of covering for their public assets. However, small, low-income and highly exposed countries can make use of sovereign insurance in order to transfer risks of public sector assets and relief expenditure (IPCC 2012, p. 343, 372) as they are otherwise "unable to raise sufficient and timely capital to replace or repair damaged assets and restore livelihoods following major disasters" (IPCC 2012, p. 360).

If covered by sovereign insurance, national governments do not need to rely on donor support. Hence, they are more independent in decision-making, and there are less insecurities concerning the size, time, and frequency of the payout. On the downside, in contrast to direct insurance schemes such as microinsurance, with this arrangement individuals remain to be at the government's mercy in case they are only covered indirectly.

## 2.2 Other approaches to transferring risk

### CATASTROPHE BONDS AND RESILIENCE BONDS

Over the past decade, catastrophe bonds (otherwise known as cat bonds) have emerged as an alternative risk-transfer product, especially to handle catastrophic risks like earthquake and hurricane, which the insurance industry had partly avoided before (UNFCCC 2008, p. 44). These kinds of bonds bring natural disaster risks into the capital market: issuers of cat bonds use them to fund payments if a specific catastrophic event occurs, in which case buyers can lose the entire principal (Skees et al. 2007a). In return, investors receive regular interest payments (the coupon), reflecting the probability of loss of the capital invested (UNFCCC 2008, p. 44), i.e. the probability for the catastrophic event to occur. Cat bonds, which are typically in place for three to five years, are index-based products as they are triggered "when a disaster reaches a predetermined threshold" (Refocus Partners 2015, p. 2). Originally, they provided an alternative to traditional reinsurance for insurance companies, but they have increasingly been used not only by public or quasi-public entities but also by large asset holding entities (Scism 2015; Refocus Partners 2015, p. 31).

One major advantage of cat bonds is that they spread the risks of a major catastrophic event, which would result in substantial financial losses. According to John Soe, a hedge fund manager specialized in cat bonds, "they [are] the ideal mechanism for dissipating the potential losses to [...] insurers [and other bond issuers] by extending them to the broader markets" (Lewis 2007) and hence a large group of investors. Moreover, the UNFCCC (2008) describes cat bonds to be an attractive investment due to the fact that the likelihood of the occurrence of a triggering event and thus the default of the bond is uncorrelated with any other default risk, providing "diversification of the investment portfolio whilst attracting good rates of return" (p. 44).

On the downside, the possibility of basis risk remains as the default is triggered by an index reaching a pre-specified level instead of an evaluation of actual losses (Elabed, G. et al. 2013). Basis risk also exists due to the fact that total payouts are limited by the size of the issued bond (Refocus Partners 2015, p. 40). However, it should be noted, that recent studies have shown the that the level of basis risk is comparable with the residual risk that is associated with individual insurance (Castillo, M. et al. 2012) Furthermore, if physical damage are caused by a source other than the specified catastrophic event, no compensation will be paid (UNFCCC 2008, p. 85).

In order to additionally reduce the physical risks of disasters, the RE: bound program has recently put forward the idea of converting cat bonds into resilience bonds, which are designed rather identically. The main distinguishing feature is that resilience bonds incentivize making investments in physical risk reduction projects by offering lower coupon pricings reflecting the reduction in expected losses in case risk reduction measures are implemented (Refocus Partners 2015, p. 33). Consequently, resilience bonds help to reduce vulnerability before a disaster strikes by stimulating prevention.

## WEATHER DERIVATIVES

Weather derivatives have emerged in the late 1990s as another risk transfer mechanism (UNFCCC 2008, p. 44; Gandel 2012). A weather derivative is a financial contract which can be used by individuals or organizations. It typically takes the form of forward contracts or options ("call" and "put"), and its value is determined by a weather index, for example temperature, rainfall, or snowfall (Skees et al. 2007a, p. 12). For instance, a ski area could pay a certain premium to collect a specified amount for every inch of snow below a strike amount ("put" option), or the ski area could collect a certain premium and pay a specified amount for every inch of snow above a strike amount ("call" option) (Jones 2001). The major difference between insurance and derivatives is that derivatives are usually tradable (Skees et al. 2007a, p. 12).

Advantages of weather derivatives (as an index-based insurance instrument) include low moral hazard and adverse selection, less complex contracts and timely payout (UNFCCC 2008, p. 102). Similar to cat bonds, drawbacks of weather derivatives are the existence of basis risk and the fact that no compensation will be paid in case of damage caused by a source other than precisely the one previously specified (UNFCCC 2008, p. 85). Weather derivatives are not regarded as insurance or reinsurance instruments by insurance regulations in many countries. Hence, such that insurance companies wishing to use weather derivatives will be required to keep in reserves the full amount of the outstanding insured risks (UNFCCC 2008, p. 64). Skees et al. (2007a) claim that weather derivatives are generally "not well suited for developing countries [as they are] standardized products which require sophisticated markets and regulation, all of which are constraints to their use for agriculture in developing countries" (p. 19).

## 3. IMPLEMENTATION OF RISK TRANSFER MECHANISMS SO FAR

This section presents an overview of whether, where, and how well established the various disaster risk transfer mechanisms are in the less and least developed world. The GIZ (2015) reports a total of 100 million people currently being protected by different kinds of climate risk insurance. The following overview is not considered to be a review of all existing schemes but aims to provide conclusive and fact-based information and examples.

### 3.1 Classic insurance schemes

#### MICRO-LEVEL INSURANCE

According to the IPCC (2012), microinsurance schemes hedging against risks such as death or illness are widespread, "but applications for catastrophic risks to crops and property are [only] in the beginning phases" (p. 524). The vast majority of microinsurance schemes is index-based as traditional insurance "has failed in many countries, mainly because of the high costs associated with settling claims on a case-by-case basis" (Mechler et al. 2006, p. 9).

The *Agriculture and Climate Risk Enterprise (ACRE)* is described to be the largest index insurance program in the developing world, working with local insurers to mainly offer crop insurance to smallholders in Kenya, Tanzania and Rwanda. For its core product, the ACRE makes use of rainfall data to assess and compensate crop losses, but it also offers insurance against death of livestock (GIZ 2015, ACRE 2015).

The *R4 Rural Resilience Initiative* (former Horn of Africa Risk Transfer for Adaptation, HARITA) is another program targeted at Africa. It is currently active in Senegal and Ethiopia, where 26,000 smallholders have been reached by now, and aims to extend to Malawi and Zambia. The initiative provides insurance, among others, to poor farmers and other food insecure households, who are given access to insurance by paying into Insurance-for-Assets (IfA) schemes with their own labour. When a drought hits, as indicated by a specified weather index, policyholders receive compensation (World Food Program 2015, 2016).

In order to protect individuals in the Caribbean, more specifically St. Lucia, the *Livelihood Protection Policy (LPP)* does not only pay out when threshold values for rainfall or wind are exceeded, but also warns policy holders about approaching weather events via text message in order to enable them to employ risk reduction strategies (Munich Climate Insurance Initiative (MCII [no date a]).

In India, several different disaster microinsurance schemes are in place, covering the loss of life or property, among others, caused by natural disasters. The *All India Disaster Mitigation Institute (AIDMI)* offers the disaster insurance program *Afat Vimo*, which protects households and microbusiness owners from several major types of disasters such as earthquake or flood in return for small annual premiums (Mechler et al. 2006, p. 18). Another insurance product is offered by *BASIX*, a microfinance institution, to address high loan default rates and protect smallholder farmers from damages caused by excessive rainfall (Skees et al. 2007a, p. 24). As reported by the UNFCCC (2008), this was the "first micro-level rainfall insurance in the world" (p. 66). Allianz SE's Group Economic Research presents a number of other insurance schemes in Asia, which are specifically targeted at agricultural firms and households (2016b).

In Pakistan, a pilot project creating a *National Disaster Insurance Fund* for protecting poor people at risk of extreme weather is still in design (MCII [no date b]). In Bangladesh, the NGO *Proshika*, a microfinance institution, offers an insurance which is bundled with savings. In case of damage due to flooding, clients receive indemnity payments twice the amount in their savings account (Mechler et al. 2006, p. 11; UNFCCC 2008, p. 92). In Malawi, an insurance product protecting farmers against drought is offered bundled with a loan to foster investment in improved seeds. In case the associated drought index exceeds a specified level, the lender receives an insurance indemnity (Skees and Collier 2008, p. 17).

### MESO-LEVEL INSURANCE

In Peru, microfinance institutions are covered by an index-based insurance scheme, protecting from loan defaults in response to crop losses due to heavy rainfall and massive flooding caused by El Niño. Payouts are triggered if a sea surface temperature index exceeds a predetermined strike value, and they are commensurate with by how much the strike value is exceeded (Skees et al. 2007b).

Similarly, in Vietnam, creditors are protected from costs resulting from default risk and restructuring the loan portfolio due to excess water levels as indicated by measurements at a hydrological station. Intermediaries who purchase an index insurance contract receive a one percent payment for every centimetre above a strike value (Skees et al. 2007b).

The *Loan Portfolio Cover (LPC)* offers policies to financial institutions in the Caribbean, more specifically Jamaica, St. Lucia and Grenada, to protect their loan portfolios from extreme climate events and subsequent loan default. Payouts are made if previously specified values for wind speed and/or rainfall are exceeded (MCII [no date c]).

Another form of meso-level insurance is to be found in Uruguay, where it is not a microfinance institution, but an electricity company that is covered by weather insurance. Uruguay strongly dependent on its hydroelectric plants to supply the country with electricity, making it vulnerable to droughts. Therefore, the state-owned electric company entered into a weather insurance contract with the World Bank treasury, where payments are triggered when water levels fall below a critical value. The compensation payments are used for purchasing oil as another source of energy to provide the county's inhabitants with electricity (Swiss RE 2015).

In Bangladesh, it is the local NGO Manab Mukti Sangstha working with community-based organizations and individual households which is covered by a flood insurance scheme. Payouts are determined by an index combining information on the water level and the number of flood days and are then distributed to households (Swiss RE 2015).

### MACRO-LEVEL INSURANCE

In Mexico, the government has set up the natural disaster relief fund *Fondo de Desastres Naturales (FONDEN)*, which "provides rapid insurance payouts to help the public sector manage disaster situations" (GIZ 2015). This includes the repair of uninsured infrastructure, such as  roads, bridges, and schools, and relief for low-income individuals

(GIZ 2015; UNFCCC 2008, p. 67). According to a recent report published by Swiss RE (2015), in addition to reconstruction, FONDEN now increasingly focuses on prevention. Resources are allocated to the fund through the Federal Budget. It has to be borne in mind that despite the fund functions like an insurance and is regarded as one by the GIZ.

For protecting other Central-American countries highly exposed to hurricanes and earthquakes, the *Caribbean Catastrophe Risk Insurance Facility (CCRIF SPC)* was set up in 2007 as the world's first catastrophe risk insurance pool, providing coverage to 16 Caribbean island states (IPCC 2012, p. 420, p. 524). Participating countries, such as the Bahamas, Barbados, Haiti, Jamaica, and Nicaragua[1], pay membership fees and receive immediate payouts to cover parts of the costs incurred by a natural disaster in return (IPCC 2012, p. 524). Additional funding is provided by the European Union (EU) and the World Bank, among others (GIZ 2015). Payouts are triggered by an index for hurricanes, as measured by wind speed, and an index for earthquakes, as measured by ground shaking (IPCC 2012, p. 420).

The *African Risk Capacity (ARC)* and its affiliate insurance company, the African Risk Capacity Insurance Company Limited is another disaster risk pool which was established as a Specialized Agency led by the African Union (AU) in 2012 (ARC 2016a; Swiss RE 2015). It aims at protecting African countries against droughts as indicated by a precipitation index (GIZ 2015). Initially, five African countries, namely Kenya, Mauritania, Niger, Senegal, and Mozambique were covered by drought insurance (ARC 2014). The second group of countries which joined in 2015 comprises Burkina Faso, The Gambia, Malawi, Mali and Zimbabwe (ARC 2016d). By 2020, the ARC aims to reach up to 30 of the 54 AU member countries (Swiss RE 2015). The capital mainly comes from participating countries' premiums, which are calculated based on the individual country's selection of the amount of financing it wishes to obtain from the ARC in case of droughts (ARC 2016b). Payouts are described to be made to national governments within two to four weeks of the end of the rainfall season if a predetermined critical threshold of the precipitation index is crossed (ARC 2016c).

## Sovereign insurance: Pilot projects

In Mexico the government has insured its emergency relief expenditure through the natural disaster relief fund FONDEN (IPCC 2012, p. 372). Sovereign insurance is also provided through the CCRIF SPC to 16 Caribbean island states (IPCC 2012, p. 372). A similar product is provided by the ARC for numerous countries in Africa is also an application of sovereign insurance.

The Turkish Catastrophe Insurance Pool (TCIP) provides another important showcase as a form of "sovereign insurance provided at a national level" UNFCCC [no date]. The TCIP is claimed to be the second largest catastrophe pool in the world (the first being the CCRIP), as of 2008. It has been set up to provide compulsory earthquake insurance to Turkey's citizens, thereby reducing the Turkish government's "fiscal exposure to earthquakes by transferring excess catastrophe risk to the international reinsurance markets" (GFDRR 2011b; The Turkish Government 1999 [English translation] ). Hence, the TCIP may be regarded to operate both on the micro and the macro level, as the Turkish government is covered indirectly through the fund's reinsurance, which protects from having to finance reconstruction in case the fund is unable to do so sufficiently. The TCIP serves as a role model to other

[1] For an overview of all participating countries of the CCRF see http://www.ccrif.org/content/member-countries.

countries highly exposed to disaster risk such as the Philippines, which are reported to be considering the establishment of an insurance pool similar in design to the Turkish one (Artemis 2014b). It is noteworthy that not only governments exposed to disaster risk through their post-disaster relief and assistance, but also donor organizations such as the World Food Program, which hedged against the risk of the occurrence of a drought in Ethiopia by purchasing index-based reinsurance (IPCC 2012, p. 372).

## 3.2 Other approaches to transferring risks

### CATASTROPHE BONDS AND RESILIENCE BONDS

In 2008, cat bonds were still a relatively "novel instrument to transfer risks" (UNFCCC 2008, p. 41). In 2015, the cat bond market had an overall volume of US$ 25 billion and had grown by 25 percent over the preceding decade, as compared to 10 percent for the rest of the insurance sector, and it is predicted to grow further (Refocus Partners 2015, p. 3; Phillips 2014). As of 2014, it has mainly focused on developed countries, the United States in particular, accounting for 75 percent of the cat bond sector as described by a 2013 BNY Mellon report, where "cat bonds are regularly used by government-sponsored insurance programs" (e.g. the California Earthquake Authority or the Florida Citizens Property Insurance) (Refocus Partners 2015, p. 3). However, the market is predicted to grow drastically in developing countries in the future (Phillips 2014).

According to the IPCC (2012), Mexico was "the first transition country to transfer part of its public sector catastrophe risk to the international capital markets" (p. 362). As a reinsurance, the Mexican disaster relief fund *FONDEN* issued catastrophe bonds amounting to US$ 315 to cover earthquake and hurricane risks between 2012 and 2015. The bonds were designed to be triggered if a storm passed through a specific coastal zone and reached a predetermined pressure level, or if an earthquake reaching a certain magnitude and depth occurred (Swiss RE 2015).

In 2014, the World Bank issued its first cat bond ever. It had a value of US$ 30 million for providing reinsurance to 16 Caribbean island states through *the CCRIF SPC* (World Bank 2014). In the same year, the *ARC*, covering a number of African countries, announced the launch of the Extreme Climate Facility (XCF) as a second financial affiliate to access private capital through issuing a series of multi-year cat bonds. Payments are triggered by an index indicating a potential change in the frequency and severity of extreme weather events in the region, and they are to be used for financing adaption measures (ARC 2014; Artemis 2014a) instead of providing financial relief in response to specific disasters.

The first ever Asian cat bond was issued in 2015 by *China Re*, amounting to US$ 50 million to cover for earthquakes (Artemis 2015c). The World Bank is currently working on an approach to transfer disaster risk for the Philippines and is taking catastrophe bonds into consideration as a source of capital after an extreme weather event (Artemis 2015b).

A rise in cat bond issuance is expected in the future for the entire Asia Pacific region, according to a 2015 report by Fitch Ratings (Artemis 2015c). Most recently, the Start Network, an international network of non-governmental humanitarian organizations, has announced to investigate and develop cat bonds as a new method of making funding available for managing a disaster, in this case pandemics (Artemis 2015a). Other NGOs providing assistance and financial relief for extreme weather events may therefore also consider issuing cat bonds as a risk transfer mechanism.

The idea of resilience bonds as a new financial product providing post-disaster relief as well as incentivizing resilient infrastructure investment was first unveiled in April 2015 and formally announced at the COP in December 2015 in Paris (Jenkins 2015). The structure has not been implemented yet, but the Refocus Partners (2015) report provides project examples of where and how resilience bonds could be used, focusing on three US cities.

### WEATHER DERIVATIVES

In developed countries, weather derivatives have been used since the 1990s, mainly by large energy companies in the US, and applications in the agricultural sector are only slowly increasing in number (Skees et al. 2007a, p. 17-19). In the past decade, international development organizations have been piloting weather derivatives in developing countries (Banerjee 2013).

Several case studies for weather derivatives in developing countries can be found in Africa. In 2002, the first weather derivative deal was settled in South Africa. *Genbel Securities*, a financial service provider, entered into a contract protecting ZZ2 Ceres, one of the country's largest fruit and vegetable producers, against early-spring frost. Payout is triggered if temperatures are zero or fall below zero degrees Celsius (Singh [no date]).

The *Climate Adaptation Development Program (CADP)* was launched in 2007 by Swiss Re in order to protect village clusters in Kenya, Mali, and Ethiopia against severe drought (UNFCCC 2008, p. 56 ff.). The program addresses the problem that financial institutions would not provide farmers with loan because of high default risk. Weather derivative contracts were developed for village clusters in the respective countries, where the payout is determined by an index correlated to crop production. It is to be used for the production and delivery of goods and services such as food aid or support for the local clinic. The project was to be extended to Ghana, Malawi, Nigeria, Rwanda, Senegal, Uganda, and the United Republic of Tanzania in 2008. At the current time, the potential of the project is not entirely clear.

Separately from the protection of village clusters in Malawi, between 2008 and 2011, the *Government of Malawi* purchased weather derivative contracts structured as put options on a rainfall index. Payouts were triggered if precipitation fell below a specified level, and were then used to lock maize prices before they increase due to poor harvest (Global Facility for Disaster Risk Reduction and Recovery (GFDRR) 2011a). Another showcase for weather derivatives can be found in Morocco. The contracts, which are sold in the form of an insurance contract by the agricultural mutual insurance company *MAMDA*, are designed as a European put option, and payouts are triggered when a rainfall index falls below a specified threshold (Stoppa and Hess 2003).

Outside of Africa, examples of weather derivatives in developing countries can for example be found in India, where the microfinance institution *BASIX* provides weather index insurance to smallholders, thereby protecting them from excessive rainfall (Banerjee 2013, p. 6; Skees et al. 2007a).

## 4. ECONOMIC VIRTUES OF CLIMATE RISK INSURANCE

Extreme weather events lead to a decline in agricultural output and disconnects in the agricultural production cycle among others, which is especially severe in developing countries, where the economy heavily relies on the agricultural sector for livelihoods, production and employment. Take Ethiopia for example, where agriculture accounts for roughly 40 percent of the nation's output and employs 80 to 85 percent of the population, according to the Food and Agriculture Organization of the United Nations (FAO) (Mengistu 2003). Here, droughts alone have been estimated to reduce total gross domestic product (GDP) by 1 to 4 percent (Group Economic Research / Allianz SE 2016a). A decline in agricultural output reduces employment and creates food scarcity, thereby increasing the incidence of poverty and reducing economic growth, which "jeopardize[s] sustainable development, and exacerbate[s] migration and conflict" (GIZ 2015, p.1).

Insurance is needed to compensate for the instantaneous loss in agricultural output and to averting long-lasting consequences for agricultural production caused by an interruption of the agricultural cycle. A cost-benefit analysis examining the economic advantages of establishing a risk pooling facility such as the *ARC* as a rapid response mechanism has found that "getting aid to households in the critical three months after harvest could result in economic gains of over USD 1,200 per household assisted" (ARC 2012, p. 4). Not only do extreme weather events reduce economic growth directly by disrupting agricultural production and threatening future production, but they can also have an indirect impact by raising the degree of income inequality (Mideksa 2010). Here, insurance contributes to mitigating the adverse effects of climate change by making sure that more heavily affected regions, do not fall behind further.

Economic growth and development is also impacted by underinvestment ensuing from the sheer risk of damage caused by extreme weather events. The risk of credit default in response to poor harvest caused by an extreme weather event raises the cost of providing financial services. Hence, credit is only supplied at unaffordable prices. For instance, this reduces the opportunity of investing in productivity enhancing fertilizers (Hellmuth et al. 2009, p. 5). Meso-level insurance schemes may serve as a way to reduce the negative consequences of default to creditors, thereby enhancing the investment and growth potential. There are also demand-side obstacles to investment. Uninsured individuals are likely to avoid taking risks through an investment or innovation which could potentially increase productivity, "since these innovations may increase their vulnerability" (Hellmuth et al. 2009, p. 2). In this case, both meso-level and microinsurance can provide security to farmers.

In order to incentives external businesses to invest and physically locate in areas prone to extreme weather events, special zones based on the model of Enterprise Zones or Charter Cities[2] could be created. In such zones, in addition to offering tax relief or financial grants, macro-level insurance could provide extra protection against climate risk, thereby giving businesses more planning security as compared to other regions, which is crucial for investment.

Developed countries may also benefit economically from supporting the implementation of insurance in developing countries. Without insurance, "climate impacts could lead to a downward socio-economic and humanitarian spiral" (UNFCCC 2008, p. 20), leading to not only economic dependence, but also geopolitical conflicts and migration, which is likely to incur even more lives lost and overall higher costs.

## 5. CONCLUSION

It is the less and least developed countries with low-level infrastructure and insufficient prevention policies – mostly African and Small Island States – which are greatly affected by climate change and its negative repercussions. Not only are these states the most

[2] For more information on Special Economic Zones, and Enterprise Zones and Charter Cities in particular see (Group Economic Research / Allianz SE 2015b).

exposed to the direct consequences, but they are also the least capable of reducing the risks and recovering from them (IPCC 2012, p.7; GIZ 2015, p.1).

Insurance may play a substantial role in protecting vulnerable countries from climate change. Various classic insurance schemes on the micro-, meso- and macro-level exist, and there are further alternative approaches to transferring climate risks. Such risk transfer mechanisms do not only contribute to reducing the adverse effects of extreme weather events caused by the disaster directly. Furthermore, they can provide incentives for strengthening resilience prior to the disaster and for faster local learning and competence building. Moreover, insurance fosters investment as it reduces uncertainties. Such investments can be utilized for resilience infrastructure or in order to create “greener cities” (Group Economic Research/Allianz SE 2014) and hence contributing to the reduction of greenhouse gas emissions, which mitigates the process of climate change, and hence the frequency and intensity of extreme weather events and their negative repercussions altogether. However, problems arise when setting up insurance schemes in developing countries, which are mainly related to the concentration of risk, the question of ownership, and difficulties in quantifying damages. Lack of data, restrictive regulations, small scale of operations, and potential for moral hazard may also impede the establishment of formal risk transfer schemes (UNFCCC 2008, p. 30, p. 6).

It has to be borne in mind that an increase in the frequency and severity of floods or droughts and the question how to cope with it does not only concern the developing world, but is rather sooner than later also going to be a highly relevant issue in developed regions such as Europe, requiring rethinking today’s insurance approaches and business models as well (Group Economic Research / Allianz SE 2014b, 2015a).

## REFERENCES


Agriculture and Climate Risk Enterprise (ACRE) (2015). *Products.* http://acreafrica.com/

African Risk Capacity (ARC) (2012). *ARC Response to the Cost-Benefit Analysis of the African Risk Capacity.* http://www.africanriskcapacity.org/documents/350251/371565/ARC_CBA_and_Response.pdf (last accessed on 22 March 2016)

African Risk Capacity (ARC) (2014). *ARC Extreme Climate Facility (XCF).* Presentation by Dr. Richard Wolcox. 5th International Disaster & Risk Conference IDRC Davos 24-27 August 2014.

African Risk Capacity (ARC) (2016a). *Vision and Mission.* http://www.africanriskcapacity.org/about/vision-and-mission (last accessed on 22 March 2016)

African Risk Capacity (ARC) (2016b). *ARC Agency Treaty Signatories.* http://www.africanriskcapacity.org/countries/signatories (last accessed on 22 March 2016)

African Risk Capacity (ARC) (2016c). *How ARC works.* http://www.africanriskcapacity.org/about/how-arc-works (last accessed on 22 March 2016)

African Risk Capacity (ARC) (2016d). *Risk Pool II.* http://www.africanriskcapacity.org/de/risk-pool2 (last accessed on 22 March 2016)

Artemis (2014a). *Climate change catastrophe bonds for Africa to be launched by ARC.* 23 September 2014. http://www.artemis.bm/blog/2014/09/23/climate-change-catastrophe-bonds-for-africa-to-be-launched-by-arc/ (last accessed on 21 March 2016)

Artemis (2014b). *Philippines seeks TCIP type catastrophe pool: Could lead to cat bonds.* 29 July 2014. http://www.artemis.bm/blog/2014/07/29/philippines-seeks-tcip-type-catastrophe-pool-could-lead-to-cat-bonds/ (last accessed on 21 March 2016)

Artemis (2015a). *Start Network looks to parametrics & cat bonds for crisis response.* 2 October 2015. http://www.artemis.bm/blog/2015/10/02/start-network-looks-to-parametrics-cat-bonds-for-crisis-response/ (last accessed on 21 March 2016)

Artemis (2015b). *World Bank confirms Philippines catastrophe bond discussions.* 18 September 2015. http://www.artemis.bm/blog/2015/09/18/world-bank-confirms-philippines-catastrophe-bond-discussions/ (last accessed on 21 March 2016)

Artemis (2015c). *Catastrophe bond issuance in Asia Pacific to increase: Fitch.* 21 August 2015. http://www.artemis.bm/blog/2015/08/21/catastrophe-bond-issuance-in-asia-pacific-to-increase-fitch/ (last accessed on 21 March 2016)

Banerjee, C. (2013). *Weather Derivatives Revisited: A Disclosure on Scalability, Feasibility and Sustainability*. PhD Dissertation, Hohe Landwirtschaftliche Fakultät Rheinische Friedrich-Wilhelms-Universität zu Bonn. http://hss.ulb.uni-bonn.de/2014/3556/3556.pdf (last accessed on 21 March 2016)

Castillo, Maria Jose, Stephen Boucher, and Michael Carter. *Will I be paid after a loss? Evaluating conventional versus index insurance contracts in Ecuadorean Agriculture*. working paper. UC Davis Working paper. Accessed July 2016, available at http://arefiles.ucdavis.edu/uploads/filer_public/2014/06/19/castillobouchercarternov2012_1.pdf

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) (2015). *Climate Risk Insurance: For Strengthening Climate Resilience of Poor People in Vulnerable Countries.*

Dröge, S. (2016). *The Paris Agreement: Turning Point for the International Climate Regime*. Stiftung Wissenschaft und Politik (SWP) Research Paper.

Elabed, Ghada, et al. (2013) *Managing basis risk with multiscale index insurance.* Agricultural Economics 44.4-5: 419-431.

Federal Ministry for Economic Cooperation and Development (BMZ) (2015*). Outcomes of the Elmau summit.* http://www.bmz.de/g7/en/Entwicklungspolitische_Schwerpunkte/ Klimawandel/index.html (last accessed on 21 March 2016)

Gandel, S. (2012). *No Snow, No Problem: How Wall street Profits from Weird Weather. Time* 24 January 2012 [online]. http://business.time.com/2012/01/24/no-snow-no-problem-how-wall-street-profits-from-weird-weather/ (last accessed on 21 March 2016)

Ghesquiere, F. (2007). *Sovereign natural disaster insurance for developing countries: A paradigm shift in catastrophe risk financing*. Vol. 4345. World Bank Publications.

Global Facility for Disaster Risk Reduction and Recovery (GFDRR) (2011a). Weather Derivative in Malawi. http://www.gfdrr.org/sites/gfdrr.org/files/documents/DRFI_Malawi Derivative_Jan11.pdf (last accessed on 23 March 2016)

Global Facility for Disaster Risk Reduction and Recovery (GFDRR) (2011b). *Turkish Catastrophe Insurance Pool.* http://www.gfdrr.org/sites/gfdrr.org/files/documents/DFI_TCIP__Jan11.pdf (last accessed on 21 March 2016)

Group Economic Research / Allianz SE (2014a). *Increasing Risk of Precipitation-induced Floods in Europe: Implications for Insurance*.

Group Economic Research/Allianz SE (2014b). *Investment in greener cities: Mind the gap.* Published in May 2014.

Group Economic Research / Allianz SE (2015a). *2015 Drought Report Europe*.

Group Economic Research / Allianz SE (2015b). *Special Economic Zones – Chances and Challenges.*

Group Economic Research / Allianz SE (2016a). *Extreme Weather Impacts in Africa.*

Group Economic Research / Allianz SE (2016b). *Climate Risk: Agricultural Insurance Schemes in Asia. In preparation.*

Hazell, P. and A. Rahman (eds.) (2014). *New Directions for Smallholder Agriculture. Oxford University Press.*

Hellmuth, M. E., D. E. Osgood, U. Hess, A. Moorhead and H. Bhojwani (eds.) (2009). *Index insurance and climate risk: Prospects for development and disaster management.* Climate and Society No. 2. International Research Institute for Climate and Society Climate and Society (IRI).

*Intergovernmental Panel on Climate Change (IPCC)* (2012). Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaption. Special Report.

*International Labor Organization (ILO)* (2012). Can climate be insured? http://www.ilo.org/global/about-the-ilo/press-and-media-centre/news/WCMS_186254/lang--en/index.htm (last accessed on 21 March 2016)

Jenkins, N. (2015). *The RE.bound Program Leverages Innovative Risk Transfer Solutions As a Mechanism for Resilient Infrastructure Project Finance. RE.bound press release* 2 April 2015. New York: Refocus Partners. http://www.refocuspartners.com/press-releases/refocus-partners_REbound-Program-Press-Release-20150402.pdf (last accessed on 24 March 2016)

Jones, D. (2001). *How weather derivatives work.* USA Today 11 December 2001 [online]. http://usatoday30.usatoday.com/weather/news/2001/2001-12-11-weatherderivativesqa.htm (last accessed on 21 March 2016)

Lewis, M. (2007). *In Nature's Casino.* New York Times Magazine 26 August 2007 [online]. http://www.nytimes.com/2007/08/26/magazine/26neworleans-t.html?pagewanted=all&_r=2 (last accessed on 21 March 2016)

Mechler, R., J. Linnerooth-Bayer and D. Peppiatt (2006). *Disaster Insurance for the Poor? A review of microinsurance for natural disaster risks in developing countries*. ProVention/International Institute of Applied Systems Analysis (IIASA) Study.

Mengistu, A. (2003). *Ethiopia.* Rome: Food and Agriculture Organization of the United Nations. http://www.fao.org/ag/AGP/AGPC/doc/Counprof/Ethiopia/Ethiopia.htm

Mideksa, T. K. (2010). Economic and distributional impacts of climate change: The case of Ethiopia. *Global Environmental Change 20(2)*, pp. 278-286. http://www.sciencedirect.com/science/article/pii/S0959378009001022

Munich Climate Insurance Initiative (MCII) [no date a]. *For Individuals: The Livelihood Protection Policy. LPP Factsheet.* http://www.climate-insurance.org/projects/climate-risk-adaptation-and-insurance-in-the-caribbean/latest-project-updates/latest-news/launch-of-the-livelihood-protection-policy-in-saint-lucia/ (last accessed on 21 March 2016)

Munich Climate Insurance Initiative (MCII) [no date b]. *Designing Disaster Risk Insurance Framework for Pakistan.* http://www.climate-insurance.org/projects/designing-a-disaster-risk-insurance-framework-for-pakistan/ (last accessed on 23 March 2016)

Munich Climate Insurance Initiative (MCII) [no date c]. *For Financial Institutions: The Loan Portfolio Cover.* http://www.climate-insurance.org/projects/climate-risk-adaptation-and-insurance-in-the-caribbean/the-loan-portfolio-cover/ (last accessed on 21 March 2016)

NASA (2005). *NASA – What's the Difference between Weather and Climate?* http://www.nasa.gov/mission_pages/noaa-n/climate/climate_weather.html (last accessed on 22 March 2016)

Phillips, L. (2014). *Cat bonds: Cashing in on catastrophe.* Road to Paris. http://roadtoparis.info/2014/11/18/cat-bonds-cashing-catastrophe/

Refocus Partners (2015). *Leveraging Catastrophe Bonds: As a Mechanism for Resilient Infrastructure Project Finance.* http://www.refocuspartners.com/reports/RE.bound-Program-Report-December-2015.pdf (last accessed on 21 March 2016)

Scism, L. (2015). *From the Makers of Catastrophe Bonds, a New 'Resilience Bond'.* The Wall Street Journal 9 December 2015 [online]. http://blogs.wsj.com/moneybeat/2015/12/09/from-the-makers-of-catastrophe-bonds-a-new-resilience-bond/ (last accessed on 21 March 2016)

Singh, S. [no date]. *Weather Insurance and Derivatives in Developing Countries: an Alternative to Agriculture Insurance (2)*. Appleton, Wisconsin: MicroInsurance Centre. http://www.microinsurancecentre.org/resources/documents/weather-insurance-and-derivatives-in-developing-countries-an-alternative-to-crop-insurance/download.html (last accessed on 21 March 2016)

Skees, J. and B. Collier (2008). *The Potential of Weather Index Insurance for Spurring a Green Revolution.* Forum for Agricultural Risk Management in Development. http://agriskmanagementforum.org/doc/potential-weather-index-insurance-spurring-green-revolution-africa (last accessed on 21 March 2016)

Skees, J., A. Murphy, B. Collier, M. J. McCord and J. Roth (2007a). *Scaling up index insurance: What is needed for the next big step forward?* Paper prepared for Kreditanstalt für Wiederaufbau (KfW), Microfinance Centre, LLC and GlobalAgRisk, Inc.

Skees, J., J. Hartell and A. Goes (2007b). Using Index-based Risk Transfer Products to Facilitate Micro Lending in Peru and Vietnam. *American Journal of Agricultural Economics 89(5)*, Proceedings Issue, pp. 1255-1261.

Stoppa, A. and U. Hess (2003). *Design and Use of Weather Derivatives in Agricultural Policies: the Case of Rainfall Index Insurance in Morocco.* Contributed paper presented at the International Conference Agricultural policy reform and the WTO: Where are they heading? Capri, 23-26 June 2003. Appleton, Wisconsin: MicroInsurance Centre. http://www.microinsurancecentre.org/resources/documents/products/agriculture-incl-index/design-and-use-of-weather-derivatives-in-agricultural-policies-the-case-of-rainfall-index-insurance-in-morocco.html

Swiss RE (2015). *Closing the protection gap: Disaster risk financing: Smart solutions for the public sector.* http://media.swissre.com/documents/Closing_the_Gap_2015_FINAL.pdf (last accessed on 21 March 2016)

The Turkish Government. 1999. *Governmental Decree Law No. 587 on Compulsory Earthquake Insurance.* [English Translation] Official Gazette No. 23919. Accessed on 06.07.2016 As published under: https://www.gfdrr.org/sites/gfdrr/files/publication/Earthquake%20 Insurance%20in%20Turkey%20History%20of%20the%20Turkish%20Catastrophe%20 Insurance%20Pool.pdf

United Nations Framework Convention on Climate Change (UNFCCC) (1992). *United Nations Framework Convention on Climate Change.* https://unfccc.int/resource/docs/convkp/conveng.pdf (last accessed on 21 March 2016)

United Nations Framework Convention on Climate Change (UNFCCC) (2008). *Mechanisms to manage financial risks from direct impacts of climate change in developing countries.* Technical paper.

United Nations Framework Convention on Climate Change (UNFCCC) [no date]. *Risk management approaches to address adverse effects of climate change – Insurance.* https://unfccc.int/cooperation_support/response_measures/items/4971txt.php#SI (last accessed on 21 March 2016)

World Bank (2014). *World Bank Issues its First Ever Catastrophe Bond Linked to Natural Hazard Risks in Sixteen Caribbean Countries.* Press release 30 June 2014. http://treasury.worldbank.org/cmd/htm/FirstCatBondLinkedToNaturalHazards.html (last accessed on 21 March 2016)

World Food Program (2015) *R4 Rural Resilience Initiative: Building resilience to climate change for long-term food security and livelihoods improvement.* Accessed on: 06.07.2016 Available under: http://documents.wfp.org/stellent/groups/public/documents/communications/ wfp278287.pdf

World Food Program (2016). *The R4 Rural Resilience Initiative: Building long-term resilience to climate change for food and income security.* http://www.wfp.org/climate-change/initiatives/r4-rural-resilience-initiative (last accessed on 21 March 2016

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# ANNEX

Table 1: Summary of characteristics and examples of classic insurance schemes

| Risk transfer mechanism | Micro-level insurance | Meso-level insurance | Macro-level insurance |
|---|---|---|---|
| Target Users (direct) | Low-income individuals and households | Intermediaries providing goods and services to rural markets, e.g. microfinance institutions, electricity providers, NGOs | Regional or national governments, international charity organizations |
| Premium and Payout | Low premium paid by individual policyholder, often subsidized at early stages<br>Low payout to individual policyholder, vastly index-based | Intermediaries decide on the value to be insured and are charged premiums accordingly<br>Payouts are index-based and mostly proportional to by how much a strike value is exceeded | Individual: contributions to funds from Government Budget, payout through direct access to fund<br>Pooled: premiums are paid for by participating countries and donors; countries receive direct and timely payouts from the pooling facility in case an event strikes |
| Risks covered so far | Flooding and drought causing crop loss and food insecurities, diseases and accidents causing loss of livestock, wind and rainfall endangering livelihoods | Loan default and savings withdrawal due to extreme weather event, electricity shortages due to droughts | Large costs for repair of infrastructure and financial relief to individuals incurred by extreme weather events such as droughts, hurricanes, or earthquakes |
| Examples | Kenya, Tanzania and Rwanda (ACRE); Senegal and Ethiopia (R4 Rural Resilience Initiative, to be extended to Malawi and Zambia); St. Lucia (LPP); India (Afat Vimo and BASIX); Bangladesh (Proshika, bundled with savings); Malawi (bundled with loan) | Peru; Vietnam; Jamaica, St. Lucia and Grenada (LPC); Uruguay; Bangladesh | Individual: Mexico (FONDEN)<br>Pooled: Kenya, Mauritania, Niger, Senegal, Mozambique, Burkina Faso, The Gambia, Malawi, Mali and Zimbabwe (ARC); Bahamas, Barbados, Haiti, Jamaica, Nicaragua and 11 other Caribbean island states (CCRIF) |
| Notes | The vast majority of classic insurance schemes on all levels is based on a weather index. Skees et al. (2007a, pp. 20-21) provide a conclusive table on index-based risk transfer products in developing countries. | | |

Table 2: Summary of characteristics and examples of other approaches to transferring risks

| Risk transfer mechanism | Catastrophe bonds and resilience bonds | Weather derivatives | Sovereign insurance |
|---|---|---|---|
| Target Users (direct) | Insurance companies, governments, large asset holders, NGOs | Individuals, insurance companies, governments | Governments, donor organizations |
| Premium and Payout | Coupon payments may be regarded as the premium payments, rate depends on risk exposure, thus lower for resilience bonds<br>Bond defaults such that seller receives payout (and investors lose the principal) in case a specific index crosses a predetermined value | Put: Cost of the option may be regarded as the premium, call: payouts to the other party in case of the triggering event may be regarded as the premium<br>Put: payout is triggered if the underlying index crosses a predetermined value, call: payout is received as the cost of the option sold | Premiums paid by governments to a national fund, risk pooling facility, or reinsurer<br><br>Timely payouts in case an event strikes |
| Risks covered so far | Earthquakes, hurricanes, long-term increases in the frequency and severity of extreme weather events | Excessive rainfall, drought, frost | Destruction of public infrastructure and other assets, provision of post-disaster financial relief and assistance |
| Examples | Mexico (reinsurance for FONDEN); Bahamas, Barbados, Haiti, Jamaica, Nicaragua and 11 other Caribbean island states (Reinsurance for CCRIF SPC, cat bond issued by World Bank); China (China Re)<br>Resilience bonds have not been issued yet | India; Kenya, Mali, Ethiopia, Ghana, Malawi, Nigeria, Rwanda, Senegal, Uganda, United Republic of Tanzania (CADP); Malawi; Morocco; South Africa | Mexico (FONDEN); Bahamas, Barbados, Haiti, Jamaica, Nicaragua and 11 other Caribbean island states (CCRIF SPC); Kenya, Mauritania, Niger and Senegal, Mozambique, Burkina Faso, The Gambia, Malawi, Mali and Zimbabwe (ARC); Turkey (TCIP); Ethiopia (purchased by World Food Programme) |
| Notes | | Banerjee (2013, p. 8) gives a comprehensive table of the forms of weather derivatives in different developing countries. | |